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TOWARDS AN ECONOMICAL FLEXIBILITY.

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AN ARCHITECT AND A SUPERINTENDENT OF SCHOOLS COLLABORATED ON THE DESIGN FOR A HIGH SCHOOL, WHICH STRESSED ECONOMY AND FLEXIBILITY. THEY CONSIDERED THREE ASPECTS OF FLEXIBILITY--(1) EXPANDABILITY, (2) CONVERTIBILITY, AND (3) VERSATILITY. EXPANDABILITY IS DISCUSSED IN TERMS OF SITE SELECTION AND PLANNING. CONVERTIBILITY FEATURES IDENTIFIED INCLUDE MOVABLE SPACE DIVIDERS, EITHER STORAGE UNITS OR TEACHING PANELS, WHICH COULD BE REARRANGED FOR DIFFERENT INSTRUCTION LAYOUTS. VERSATILITY IS INCLUDED IN THE AUDITORIUM DESIGN WHICH INCORPORATES THE BAND ROOM AND ASSEMBLY ROOM, AND USING FOLDING PARTITIONS, PERMITS A NUMBER OF STAGE AND SEATING CONFIGURATIONS. THE AUDITORIUM ALSO FEATURES A CIRCULAR DOMED CONSTRUCTION WHICH HAS ACOUSTIC, ECONOMIC, AND STRUCTURAL ADVANTAGES. SPECIFIC ATTENTION IS GIVEN TO (1) STORAGE LIGHTING, (2) AUDITORIUM SEATING, (3) DOORLESS CLASSROOMS, AND (4) UTILITIES FLEXIBILITY. (DM)

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TOWARDS AN ECONOMICAL FLEXIBILITY

WE write of FLEXIBILITY—a much talked of subject about which little is done. One of us is a superintendent, the other an architect. It is fitting that we write this report together because, if something is to be done about flexibility, the architect and the superintendent must get together to do it. That is our first point of emphasis.

Flexibility is an old word, but it represents a new quality of architecture. The inflexible characteristic of old school buildings is familiar to all of us. When our teaching program requires larger interior space, we cannot have it because the interior walls which hold up roofs or floors cannot be moved. When increased enrollment demands additions to our old buildings, either we have no ground space on which to put additions or the type of architecture simply will not permit them.

Yes, changing curriculum and increased enrollments are demanding a flexible type of architecture. We find ourselves in a dilemma. We like traditional architecture forms, but they will not give us the flexibility that we so desire. Therefore, we must open our eyes and shut out our prejudices so that we can

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RESEARCH REPORT 3

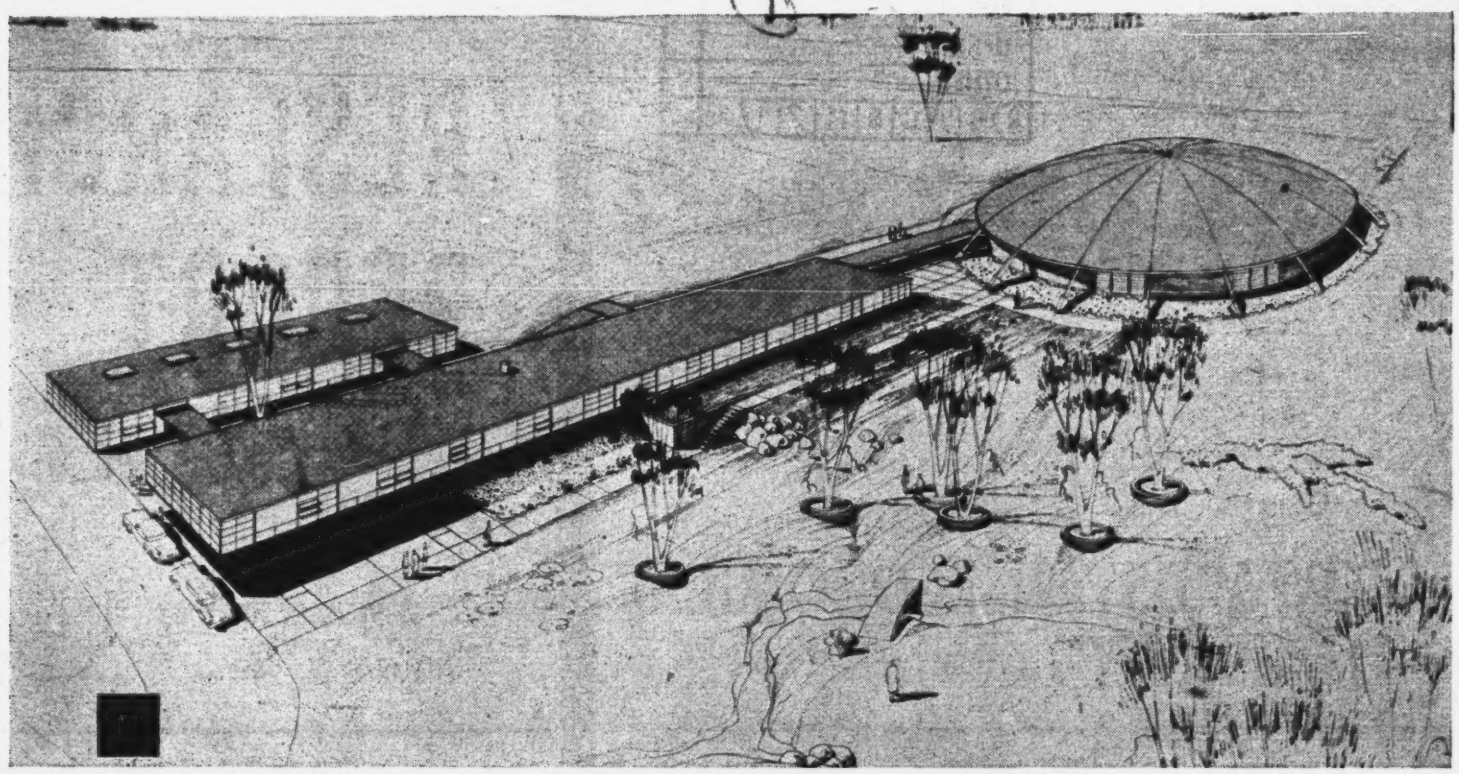
by
L. S. RICHARDSON*
WILLIAM W. CAUDILL

THE PROBLEM:

Educators and architects, with unsureness of the future, face the problem of providing more space for secondary schools. A decade of elementary school construction leaves us with few techniques that will help solve the high school space problem. Enrollment and class size predictions are difficult to make because of elective type programs, drop-outs and mobility of population. We are changing our high school curriculum to meet new philosophies and to satisfy demands by the citizenry. We will continue to change it in years to come. We exhausted our finance potential in grasshopper fashion when we erected our elementary schools. Now, with limited building funds and fresh demands for an improved high school curriculum, we must provide space for the children who engulfed our elementary schools ten years ago. The answer appears to be in an economical flexibility.

This report shows how one school district obtained an economical flexibility in the design of its new high school by (1) arranging space for an increasing enrollment, and (2) by providing space to house any type of curriculum. And on a limited budget!

CAUDILL, ROWLETT, SCOTT AND ASSOCIATES
ARCHITECTS-ENGINEERS
BRYAN, TEXAS, OKLAHOMA CITY, OKLA.



This sketch of A&M Consolidated Senior High School, College Station, Texas, designed by Caudill, Rowlett, Scott and Associates, shows the three main elements of space. The circular building on the right is the assembly-music center. The long rectangular front wing contains classrooms and the activity room which serves as the "living room" for the school. The back wing contains the laboratories. A sloping terrain makes possible an essential outdoor terrace on the level of the administration unit (left).

search for a new kind of architecture that will give us the flexibility we want. That is our second point.

We have one more to make before discussing the approach which we took in trying to find an economical flexibility. Please note, we say "approach." You, the reader, will find in this report certain solutions to our problems of changing space. However, you should remember that although these solutions are very important to us, they are not necessarily important to you. What is important is the way that we went about trying to solve our problems. Yes, the approach is the common denominator to both your problems and ours. Therefore, it is the approach that counts, not the solution. That is our third point.

Community Growth Creates Need

Our job was this. As leaders of the team of architects and teachers, we had the task of directing a coordinated effort to find answers to some difficult space problems. What are some of these problems? First, let us give you an overall picture of our situation. Ours is a college community, the home of the Agricultural and Mechanical College of Texas. Almost all of our residents, in one way or another, are dependent upon the college for their bread. Our town grew up around three sides of the college. Not until 1938 did it really expand enough to be incorporated.

The main source of income is the college. There are a few general stores for groceries and clothing. There is no industry. About 85 percent of the school taxes come from taxes on residences. Taxes for both school and city purposes are low when compared to those of neighboring towns. For that reason, and the fact that we have all of the facilities of a metropolis, people like to live here. The town is small enough, with a population of 7,000, so that there is no traffic problem.

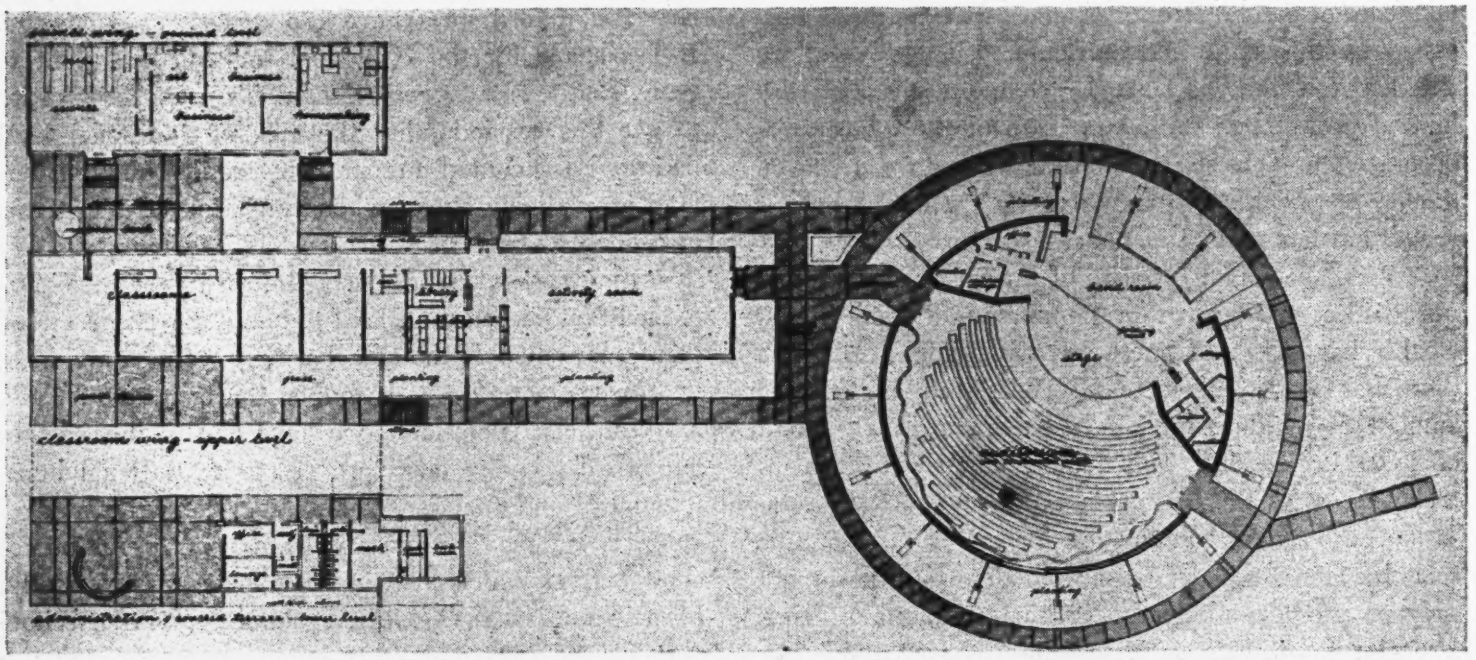
In 1950 we made a cooperative study of enrollment trends. At that time, we anticipated the high school enrollment for a period of ten years.* Four years later we found that we had missed our prediction by only four students. The enrollment growth of our school district bears a remarkable similarity to that of the nation as a whole. The gain in scholastic population is attributed to three factors: (1) an increase in the size of the college facilities; (2) an increase in the non-college residents (College Station is a bedroom-community to Bryan); and (3) an increased birth rate.

These factors have created a real housing problem in our elementary grades, particularly during the last four years. The surge is now beginning to reach our secondary school. We have every indication that the rate of enrollment flow into our secondary school will increase; therefore, our problem and probably yours too, is difficult. How can we plan our secondary school plant to take care of this surge? We believe the answer is flexibility.

Changing Curriculum Requires Flexibility

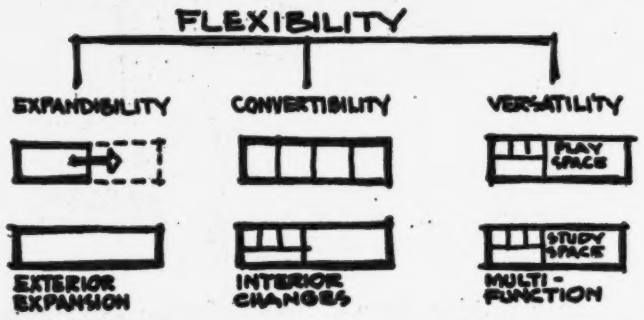
When the two of us sat down with our respective staffs to analyze the educational space needs, about

* *"Your Schools"* by W. W. Caudill, Texas Engineering Experiment Station, College Station, Texas, 1950, p. 18.



This is the floor plan of the A&M Consolidated Senior High School which is now under construction. The assembly-music center on the right is designed to seat 600 people during programs with as many as 250 performers, but can be expanded, by using the band room, to seat nearly 900 during special occasions such as commencement. The school building is on three levels. The top level contains the classroom wing and the assembly-music unit. The second level, or stair landing, contains the laboratory wing. And the lower or street level contains the administration unit.

the only thing that we could agree upon concerning the future program of our school district was that none of us knew what it would be. We could have licked this secondary building education problem if we had been satisfied to come out with a formula which said, "For every so many students, we must have one science laboratory, one homemaking laboratory, five academic classrooms, etc.," and that, "A library shall have so many square feet for every pupil enrolled, a cafeteria shall have so many square feet for every pupil, etc." No such formulas are for us, and we have a hunch that these rigid standards are not for you, either, even if you did know your exact future enrollment. The curriculum is not static in College Station. We doubt if it is static any place. It changes from day to day, child to child, and community to community.



We decided it would be foolish to plan the high school around our present curriculum, labeling doors with subject matter headings—English, social studies, mathematics, art, library, science, etc. We did that with our present high school, which is only four years old, and which now will be converted into a junior high school. A room we had planned as a library is now an art room, a planned science room is now a social studies room, a study hall-library is now subdivided into classroom space. Yes, during this four year period many internal changes have taken place in the building because of curricula changes. Our new high school must be designed to take care of this changing program for the next ten to twenty years. That was our problem, and perhaps it is yours. Apparently the solution was flexibility, whatever that may be.

What Is Flexibility?

Flexibility means different things to different people. To some, it means that quality that allows for expansion. To others, it means the quality of being movable. To others, it means changeable; and to still others, flexibility is just a word that is associated with an up-to-date school building. During our programming process, we decided that we had to pin down the word since it meant so many things to so many people. We agreed that it therefore must have some general meaning.

For our purposes of planning we broke flexibility down into three separate words—expandability, convertibility, versatility. We agreed that expandability is the word which defines the quality of efficient exterior expansion. Convertibility is defined as the quality of efficient interior changes, and versatility is defined as the quality which allows multi-function. Because of the increasing enrollment and changing curriculum, we decided that our new high school architecture must have the *quality of expandability* to take care of this surge of children and such new courses that require additional space. We decided that our new high school architecture must have the *quality of convertibility* to

take care of certain interior changes that are made necessary by this surge and curriculum changes. And we decided, too, that because our community had a very limited pocketbook for taking care of the educational program, our new school building must have a certain *quality of versatility* to allow for high utility of space—space that has many functions.

We have a real problem of limited finance. While our district has grown in population, a gain in tax wealth has not been increased accordingly, although there has been some increase. Texas statutes limit the amount of building fund indebtedness by the amount of local tax wealth. This factor, along with the increased cost of education, places a pretty definite limitation on building construction for our College Station schools. Therefore, our job as school planners was not only to provide adequate facilities at minimum cost, but also to provide such facilities which would take care of a continual enrollment growth and a changing curriculum. That meant to us that we had to seek an economical flexibility.

Planning for an Expandable Plant

First, we made a case analysis of our existing facilities. The entire community was brought in on this survey, and many suggestions were offered. Since crowded elementary classrooms were still a problem, some of the people wished to build more elementary classrooms instead of high school rooms. Some wanted to build these new elementary classrooms on the same site. Others wished to start new elementary schools elsewhere.

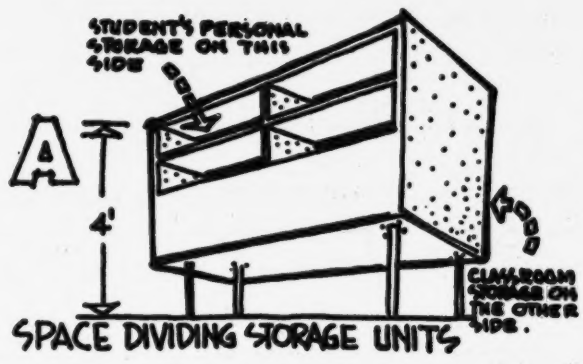
The more forward thinking people in the community anticipated this surge of children into the high school and decided that it would be more economical in the long run if the present school plant, which houses grades 1 through 12, was expanded with emphasis given to the building facilities of the upper grades. This latter group won out after a much heated community debate, and it was decided to buy twenty additional acres adjoining the present site. It was also decided to convert the relatively new high school into a junior high school building, and to reorganize the school system from a 5-4-3 plan to a 4-4-4 plan. With this additional twenty acres, we started developing a master plan which would allow our community school to grow effectively and economically.

It might be pointed out here that there had been little success in the past four building programs in obtaining a unified school plant, and at least three extreme types of architecture were evident. Our plans call for pulling these three types of architecture together into a beautiful unified scheme. It will take some years to accomplish this, but the unified plan allows this to be done in an orderly manner. The most important thing about the master plan, as the sketches show, is that it does have the quality of expansion. It has space for the individual units of the plant to grow. And it is inexpensive! Yes, it is true that in order to get this expandability the cost of additional land had to be included in our construction budget. But land is relatively cheap when you think of it in terms of a good investment.

In 1939, when our school board members purchased fourteen acres of land to house our entire school plant, many people thought that they were crazy. Whoever heard of putting a school on fourteen acres? Now, only fourteen years later, we have had to buy twenty additional acres to take care of our educational housing needs and that is not enough. The writers advocated obtaining 80 additional acres with provision for combined city and school playgrounds until it would become necessary to use it exclusively for the school system. We believe that twenty years from now the community will wish they had purchased it. To obtain the quality of expandability, land is necessary, but in our section land is relatively cheap. Despite the fact that some of the planners felt that our master plan really calls for more land, we have obtained the quality of expandability and we have purchased it at a low figure.

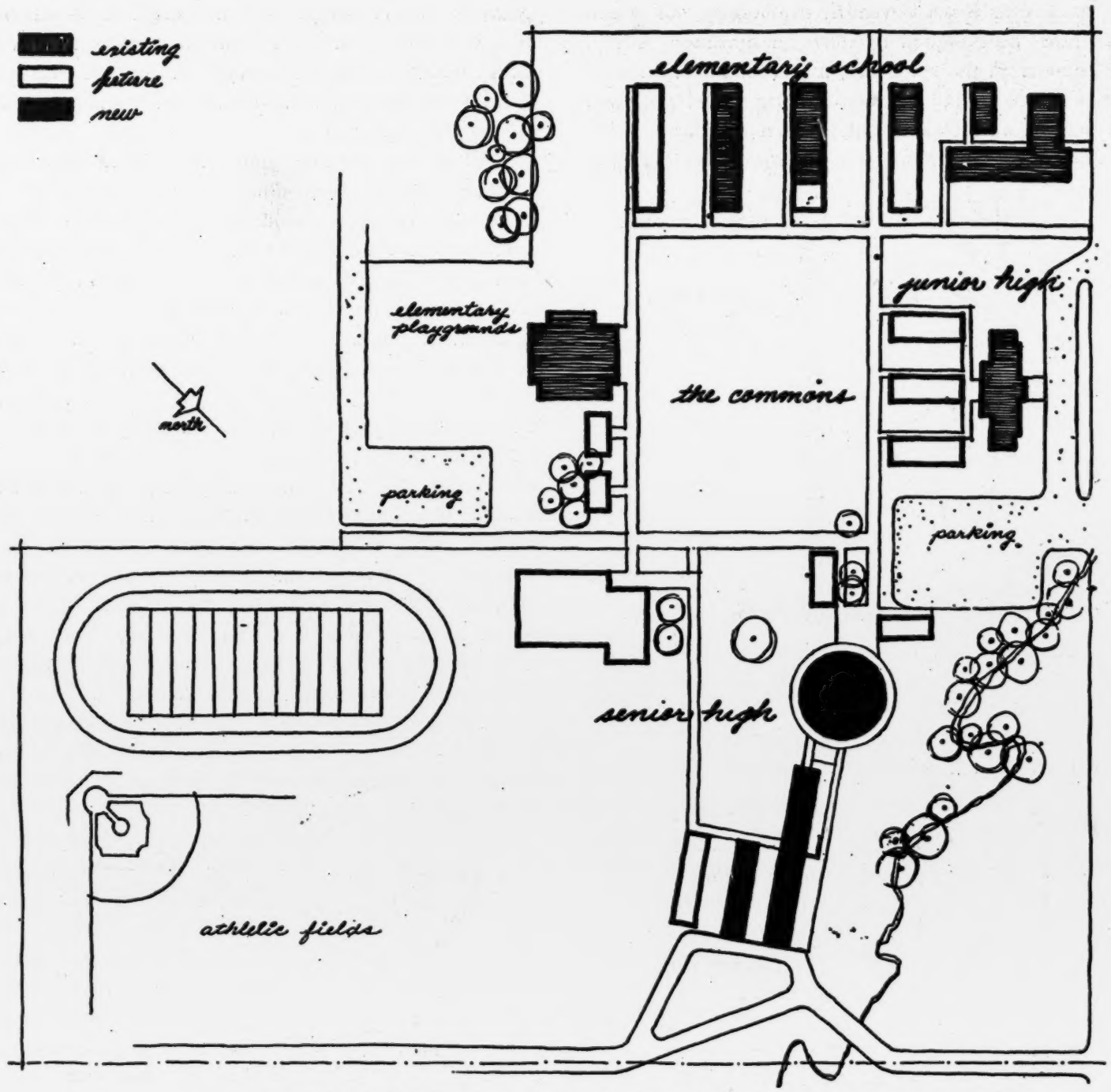
Planning for Convertibility

Much has already been said about the changing curriculum. All of us on the planning team were fully aware that since teaching methods vary, so do space requirements. Teaching methods will vary from teacher to teacher, from one group of students to another, and from one year to the next. Materials and equipment for teaching will also vary. Only four years ago the school district had followed the curriculum approach to design of a high school, and had designed a building



based on a rigid pattern of rooms for an existing curriculum and a current corps of teachers and administrators. It was found that such tailor-made facilities do not fit the next program.

During the early conferences of our planning team someone said, "Why don't we build a building so flexible that we can design and construct the arrangement in August for the program which we know will be with us in September." To most of the planning team,



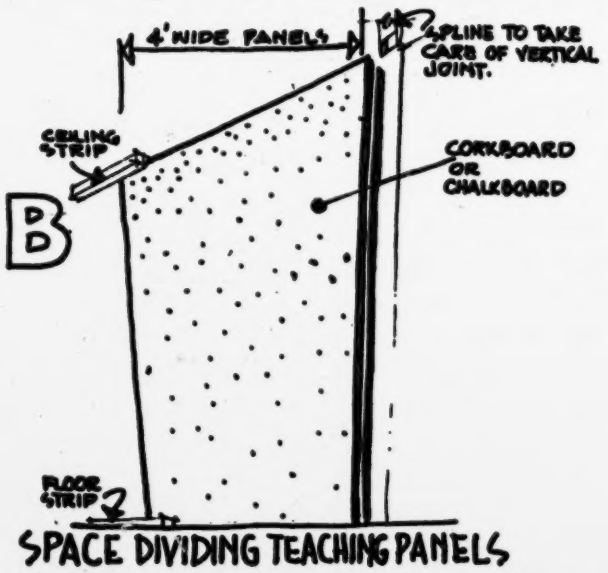
Here is the plot development plan for the entire school plant at College Station, Texas. The new A&M Consolidated High School is shown in black. The gray building blocks are existing buildings. The outline blocks are future buildings and additions. The current building program included the purchase of 20 additional acres, the rectangular area on which the high school is located, which brings the total area for the entire plant, as shown here, to 34 acres. The creek and trees north of the new high school will provide many opportunities for outdoor learning situations.

this sounded facetious. However, one of the planners who did not know any better said, "Why not?" That settled us down. Why not? Office building arrangements are never designed for a fixed operation. Companies move in and out all the time. Why not design our school like an office building? So we did.

Our classroom wing, as the sketches show, actually is one big loft. This loft can be subdivided economically and efficiently with what we call space dividers. In our case, we have two types of space dividers. One type, identified as Unit A, is a movable storage cabinet unit which provides pupil book storage, classroom shelves and material storage. Unit B is a space dividing teaching panel, 4 feet by 8 feet. Wall panels can be grouped together to form teaching walls. These panels have chalkboard surfaces or tackboard.

Economy was achieved by using these teaching surfaces as the walls themselves. Most schools have these materials pasted over regular wall materials and, consequently, the construction cost is padded. Our bids gave evidence that these two types of space dividers are economical. Our classroom and laboratory wings are therefore like office buildings. Each wing will have movable space dividers to meet the many space changes that enrollment and the curriculum demand. That is what we call convertibility. Our cost figures show that we have obtained this quality of convertibility without added expenses.

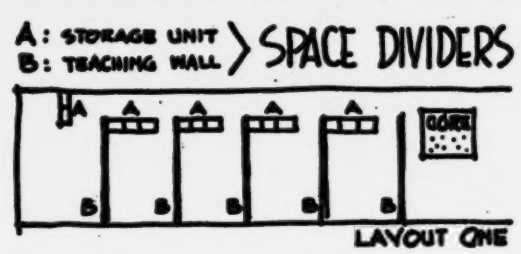
Since ours is not a wealthy community, our school plant must be designed to allow for maximum utility. We knew from the start that, if possible, every square foot of space should be used for the school program. We wanted our school plant to be more than a place for dispensing knowledge or a storehouse for our children during the day. We wanted our new school to aid in the growth and the development of the individual; and we wanted it to be a real instrument of community living. That meant to us that the school had to be much more than a shell subdivided into cells called classrooms. It needed to facilitate indoor and outdoor meeting places of small and large groups. It needed to provide a social environment and space where children and adults alike can gather to talk over individual and community problems. What we wanted was a school plant which made possible opportunities for democratic processes and for developing leadership. To do this we knew that large and small auditoriums were required, social lounges were necessary and outdoor terraces would be highly desirable. Also, special rooms for school government were needed.

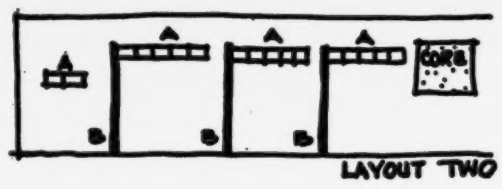


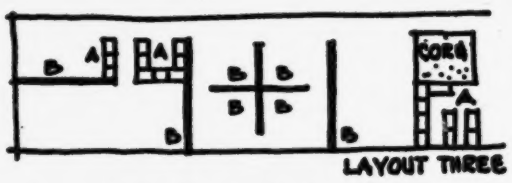
SPACE DIVIDING TEACHING PANELS

All of this required much more space than our community could afford—unless we could incorporate a quality of versatility into our architecture which would make certain spaces serve more than one function. After a great deal of study on how to obtain such versatility, our planning team arrived at a scheme for a combination assembly-band room building which allows for many activities. For example, this scheme provides for excellent seeing and hearing conditions for an audience of 600 people viewing and hearing as many as 250 performers.

During the educational program stage it was decided that we have been building high school auditoriums wrong these past few years. As one member stated it, "most of our high school stages are copied after the legitimate theatre where at the most ten or twelve people perform. Our high school must have many more performers if we believe that more learning takes place behind the curtain than in front of it." In order to get this large stage within the scope of our pocketbook, we developed a scheme which provides for the conventional small stage to be adjacent to the band room. By the use of a folding partition the band room can be thrown open as a part of the larger stage during those performances which require many performers. This sort of versatility does not cost the taxpayers any extra money. The practice rooms of the band

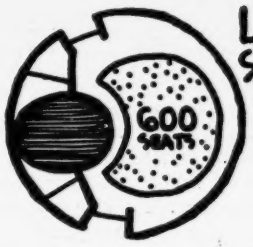




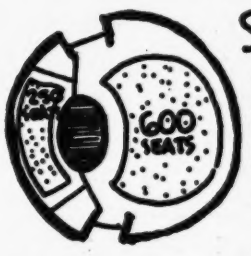


THIS SERIES OF SKETCHES SHOW THREE OF THE MANY ARRANGEMENTS WHICH THE EAST SIDE OF CLASSROOM WINGS CAN HAVE BY THE USE OF THE MOVABLE SPACE DIVIDERS

SMALL STAGE ACTIVITIES SUCH AS SMALL GROUP MUSIC, LECTURES, FORUMS, AND DRAMATICS — AND—AN UNDISTURBED BAND ROOM



LARGE STAGE ACTIVITIES SUCH AS MUSICAL FESTIVALS, FOLK DANCING, BAND AND ORCHESTRA CONCERTS.



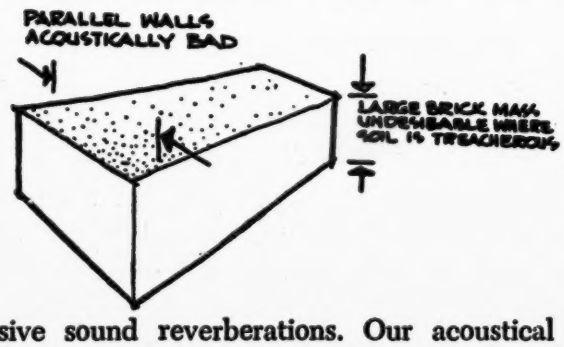
SPECIAL ACTIVITIES REQUIRING COMMUNITY PARTICIPATION SUCH AS COMMENCEMENT, CHRISTMAS PARTIES AND PAGEANTS. AUDITORIUM CAN BE INCREASED TO 850 CAPACITY. ALSO THIS ARRANGEMENT PROVIDES FOR THEATER-IN-THE-ROUND.

room are used as dressing rooms, another example of versatility. This scheme takes care of the graduation crowd, since the large stage can be used for audience seating. With such an arrangement the auditorium can be increased from 600 to 850–900 capacity. During a theatre-in-the-round program, this scheme can also seat over 800 people.

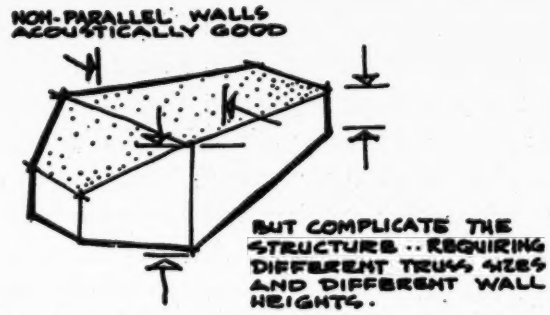
So in our attempt to incorporate this quality of versatility into our architecture, this is what we found. We do not think it is the perfect solution, but at least it is an indication to us that through very careful planning, versatility can be obtained economically.

Planning the Auditorium

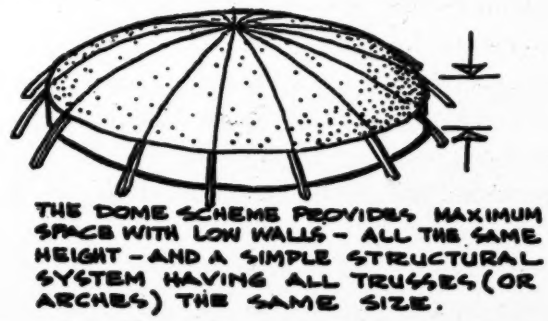
Generally, auditoriums are planned as large box-like cubes 40 feet high, 60 or 80 feet wide and so long—depending on the size. This is what we thought we would have, during the early stages of planning. In fact, the first sketch that the public saw of the auditorium was of a box-like arrangement. However, after our planning team got further into the problem, that arrangement for an auditorium did not make good sense. In the first place, the large parallel walls created



excessive sound reverberations. Our acoustical engineer, who was on our planning team, said the box auditorium was the worst architectural form we could have selected. In the second place, we found that to build this large brick mass building there was great risk involved because of shifting soil conditions. Drought in this section has resulted in the shrinking of the subsoil, cracking most of the large masonry walls in this area. The structural engineer on our planning team said, "Why can't we eliminate some of these large brick walls?"



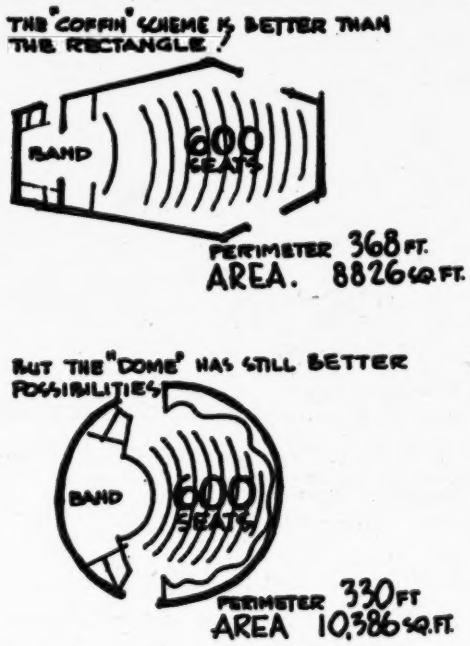
Our first step away from the box ended up in a floor plan that was shaped like a coffin. The form was suggested by our acoustical engineer. It also facilitated good seating conditions. However, after much study, it was found that it created many structural problems through necessitating walls of different heights and beams and trusses of different lengths. The next step towards a more functional shape gave us an architectural form that proved to have structural economy as well as acoustical desirability. It turned out to be a completely circular building that housed the auditorium and the band unit. From the standpoint of structure, all of the walls were the minimum height and exactly the same height, and all trusses were exactly


THE DOME SCHEME PROVIDES MAXIMUM
SPACE WITH LOW WALLS - ALL THE SAME
HEIGHT - AND A SIMPLE STRUCTURAL
SYSTEM HAVING ALL TRUSSES (OR
ARCHES) THE SAME SIZE.

the same size. Through an arrangement of some economical interior sound baffles, good hearing conditions were assured.

An analysis of the floor area, which compared the circular shape with the coffin shape, cinched the circular dome shape building as our solution. Although the coffin shape building had a larger perimeter than the circular building (368 feet to 330 feet), it had a much smaller floor area than the circular building (8,826 feet compared to 10,386).

It has already been pointed out how this building can house many functions successfully. Now let us examine a construction detail which was effected by the philosophy of flexibility—the lighting system for the stage. We found the solution in what one of the planning team called the "spider web." It is a large web-



like circular steel frame that hangs from the ceiling directly over the stage on which innumerable arrangements of light can be plugged in to provide the desired

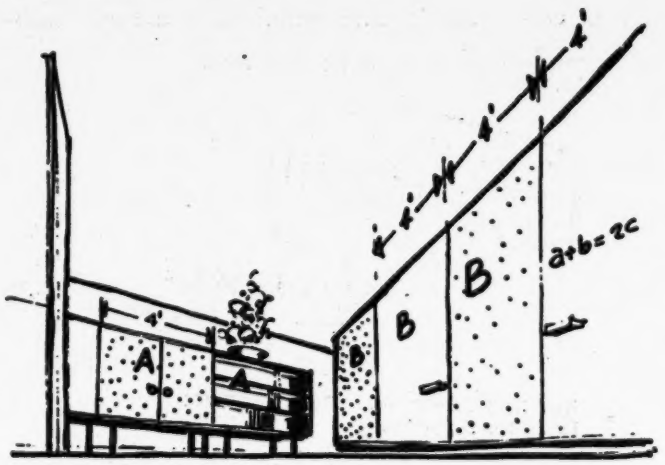
shape. From this frame also will hang the drapes, cyclorama and front curtains.

It might be pointed out here that the seating arrangement for this auditorium is not based on the conventional American style where the middle aisle is taking up the choice seats. Instead, our solution calls for the "continental plan" where each row actually is an aisle. We think that one highly significant fact in our auditorium solution is that the back row of seats is only 57 feet from the stage. We believe that the high school auditorium should be designed for high school children, not Broadway actors. It is difficult enough for experienced actors to project their voices and facial expressions in a small auditorium, not to mention children. In a large auditorium, children do not have a chance. We believe that, in this respect, our auditorium may even be too large for our high school program, but we had to compromise because our community needed a large meeting space.

It should be remembered that this auditorium is the solution to our problem, not necessarily to yours. Our point in describing it is not so much to tell you of the solution as it is to tell you of our approach in seeking this quality of versatility. We believe we found it in some small degree.

What, No Doors?

Now let's go back and examine the classroom wings and laboratory. Probably the outstanding differences between this school and your own is the fact that this school has no doors. But who ever heard of a school not having doors? Our solution calls for an open-



SPACE DIVIDERS MAY SUB-DIVIDE THE CLASSROOM AND LABORATORY WINGS IN MANY ARRANGEMENTS. UNIT "A" IS A STORAGE UNIT. UNIT "B" IS A TEACHING WALL UNIT.

ing entrance, of course, but swinging doors were eliminated after a study of classes in the existing plant revealed that all doors remain open during class periods. Elimination of the doors themselves was a saving. The real saving was in eliminating the labor cost of hanging and fitting the doors.

Won't noise from the other classes interfere with some classes? No, it does not in the existing building where the doors are open. Won't noise from traffic in the corridor disturb classes? No more than it does in existing buildings, "Anyway, no students are supposed to be in the corridor during classes," the principal said. By having no doors we have a real opportunity to provide the flexibility which we are seeking.

Actually, our classroom and laboratory wings are subdivided by teaching devices. The 4 by 8 movable panels are vertical working surfaces. The so-called wall between the corridor and the classroom is not actually a wall at all. It is a series of mass-produced multipurpose cabinets and shelves arranged to form a barrier between the corridor and the classroom. Such a barrier can be moved in a few minutes to include the corridor as part of the class area if desired. Doors would only hinder this. The result is versatility as well as convertibility.

The wall panels cannot be moved as quickly, but it requires only a good custodian to move them. It should be pointed out here that the entire ceiling surface is covered with acoustical tile to cut down the sound level throughout the building.

Flexibility and the Utilities

What about the flexibility of utilities, such as hot and cold water, drainage and electricity to laboratory spaces. In order to take care of that problem, it was decided to have two teaching wings—one for the spaces which do not require these facilities, and the other for spaces that do. However, even in the classroom wing where these facilities are not required we do have a utility core which can supply adjoining spaces with water drainage and special facilities. Of course, throughout all spaces there are plenty of convenient outlets so that regardless of how the large space is subdivided, the small spaces will be provided with them.

Conclusions

This architect-superintendent team wishes to emphasize that our plant is only one solution; it represents what we think is a pretty good solution to our problem. We are sure that there is a better one. After the building is in use, we will be in a better position to tell just how good our solution is. But the solution isn't the important thing—it is our approach that is important. Equally as important is our philosophy of flexibility.

We are convinced that since we do not know what the future educational problem will be in our secondary schools, and since we know that our school plant must grow, the only answer to our secondary school housing problem must be found in a quality of flexibility. We are also convinced that flexibility is not necessarily expensive. So the hopes for a highly functional secondary plant look good to us, if school planners approach their problem with flexibility in mind.